1. Title of the Invention

Manufacturing Method of Liquid Crystal Device

2. Scope of the Claims

1. A manufacturing method of a liquid crystal device characterized by printing an adhesive, after forming a spacer member, in the center portion of at least one electrode board, and adhering and fixing a couple of electrode boards together with an adhesive installed at the edge portion, when forming a liquid crystal display cell by arranging a couple of electrode boards, which respectively have electrodes formed on one surface thereof, to face each other, having their respective electrode formed surfaces be inner sides, and adhering and fixing their edge portions with an adhesive

2. A manufacturing method of a liquid crystal device according to Claim 1, wherein said spacer member is formed by a lithography technique including a process of a uniform film forming and a partial removal thereof

3. A manufacturing method of a liquid crystal device according to Claim 1 or 2, wherein the adhesive and the spacer member formed in the center portion of the board is formed of a polyimide resin

3. Detailed Explanation of the Invention

Technological Field

The present invention relates to a manufacturing method of a cell in a liquid crystal display device, especially a manufacturing method of a liquid crystal display cell that needs a minute gap of 1 ~ 2μm.

Technical Background

In the conventional art, a cell used in the liquid crystal display device has a constitution wherein a couple of transparent boards (12a,12b) consisting of a glass plate having a transparent electrode (11a, 11b) installed thereon are arranged to face each other, having their respective electrode formed surfaces be inner sides, and are adhered and fixed to each other in the edge portion by an adhesive (13) like an epoxy resin adhesive, as illustrated in Fig. 1. To maintain a gap for making a space (4), in which the liquid crystal is put, between the transparent boards, a cell gap is controlled by mixing a proper amount of gap controlling materials having a predetermined size like pulverized glass fibers and powders of Al_2O_3 into said adhesive (13) in advance. Otherwise, after said adhesive is formed on the transparent board by a screen printing, said gap controlling materials are uniformly scattered to adhere and fix the transparent boards, while maintaining the space between the transparent boards.

However, in the above method, it is inevitable that there is a difference in the board gap. Especially, if the board gap becomes as thin as $1 \sim 2\mu m$, the adverse influence that the difference in the board gap makes with respect to the display characteristics cannot be ignored.

Object of the Invention

The object of the present invention is to provide a manufacturing method of a liquid crystal display cell having a uniform and stable board gap, when the board gap is as minute as $1 \sim 2\mu m$, considering the above conditions.

Summary of the Invention

The liquid crystal display cell of the present invention is developed to achieve the above object, and, in a more detail, is characterized by printing an adhesive, after

forming a spacer member, in the center portion of at least one electrode board, and adhering and fixing a couple of electrode boards together with an adhesive installed at the edge portion, when forming a liquid crystal display cell by arranging a couple of electrode boards, which respectively have electrodes formed on one surface thereof, to face each other, having their respective electrode formed surfaces be inner sides, and adhering and fixing their edge portions with an adhesive.

That is, the present invention uses a separate adhesive in the center portion of the board, apart from the spacer member, and thus is supported against the compression force given when a couple of the boards are adhered and fixed, and maintains a gap determined by the adhesive after the boards are adhered and fixed. Therefore, the present invention can obtain a uniform and stable board gap. Especially, when the spacer member is formed, a film forming technique that can control the thickness in the unit of Å can be used and thus, precise gap control becomes possible. .

Embodiment

Fig. 2 is a perspective view to explain the manufacturing process of the liquid crystal display cell according to the method of the present invention.

That is, a couple of transparent boards (22a,22b) are prepared. The couple of transparent boards consist of glass plates, which respectively have transparent electrodes consisting of a ITO (Indium Tin Oxide) installed thereon, and form liquid crystal alignment, according to needs. A spacer member (25) is formed on at least one of these boards. It is desirable that this spacer member is formed by a lithography technique including a process of a uniform film forming and a partial removal thereof. Desirably, a resin material is used as the material of the spacer member, and a polyimide is desirably used, because it can form a thick film and forms a parallel

alignment of the liquid crystal. For example, after a stripe-shaped spacer member (25) having a thickness of 1 ~ 3μm and a width of 5 ~ 100μm is formed in a pitch of 0.1 ~ 2mm by a lithography technique, an adhesive (26) is formed by printing, with a proper space of 0.1 ~ 2mm between the spacer members (12), for example. A desirable example of this adhesive is an unhardened polyamide resin, which is printed by screen or offset printing method to form an adhesive stripe (13) having a thickness of 1.0 ~ 3.0μ m and a width of 0.1 ~ 0.5μm. Also, an adhesive (27) consisting of the same material (in this case, the adhesive (27) can be coated simultaneously with the above adhesive(26)) or other materials like an epoxy resin is coated on the edge portion. Then, the two boards are combined, adhered and fixed together.

Fig. 3 is a sectional view in thickness direction of an embodiment of the liquid crystal cell obtained in this manner. In this embodiment, only a polyimide resin film (28) for liquid crystal alignment is formed on the facing board (22a) that is covered with an electrode film (21a).

A specific manufacturing example of the liquid crystal display cell exemplified above will be explained.

Example 1

First, 0.3wt% of n-butanol solution of r-(2-amino ethyl) amino propyltri methoxy silan is coated on the glass board having a transparent electrode (21b) thereon by use of a spinner at the condition of 2000 rpm and 40 seconds, is hardened by being marinated at a temperature of 150°C for 30 minutes, and then 2wt% of M-methyl pyrrolidone solution of a polyimide precursor (SP-510 manufactured by Toray

industries. Inc.) is spin coated at the condition of 3500 rpm and 1 minute and is baked at a temperature of 150°C to form a polyimide film. Then, it is patternized by use of a positive resist, and then is dipped into a mixed liquor of pyrrolidone: NaOH 3% solution = 4 : 3, in which said polyimide is heated to 30°C by the mixed liquor of hydradine NaOH, for 5-15 minutes to etch the polyimide. Then the stripe-shaped spacer (25) is formed by separating the resist.

Then, 0.3wt% of n-butanol solution of r-(2-amino ethyl) amino propyltri methoxy silan is coated on the whole surface of the board, and is hardened again as described above, and then the polyimide precursor SP-510 is printed in the shape of a stripe (26 and 27) by a screen printing or offset printing method.

On the other hand, on the facing board (22a), a polyimide film (28) having a thickness of 400 ~ 500Å is formed on the ITO electrode (21a), and is rubbed. This facing board (22a) is fitted into and adhered to the board (22b), on which the adhesive is printed. Then the two boards are pressed with a pressure of 40kg/cm^2 and are baked at 240°C for three hours.

By the above process, the cell having a uniform board gap of 2μm as illustrated in Fig. 3 could be obtained.

Example 2

In the method of Example 1 above, the upper and lower glass boards are adhered to each other only by the polyimide adhesives (26 and 27). Therefore, there is a defect that separation easily occurs to solve the stress or distortion given to the glass board at the time of pressing.

To prevent this defect, this example has a structure wherein a stripe-shaped adhesive (26) of a polyimide is printed on the board (22b), the board (22b) is combined with the facing board (22a), the two boards are adhered and fixed to each other by being baked under pressurization, and again an epoxy adhesive (27) is coated and hardened on the edge portion for reinforcement and sealing. In this example, the reinforcement by the epoxy adhesive (27) was performed, while the two boards being pressed, but it is possible to make reinforcement by the epoxy adhesive (27), while the press is open.

Effects of the Invention

As explained above, the present invention provides a manufacturing method of a liquid crystal display cell, wherein an adhesive installed in the center functions as an adhesive and a spacer member, and a board gap is uniform and stable when the board gap is as minute as 1 ~ 2μm by printing an adhesive after forming a spacer member in the center portion of the board, and adhering and fixing boards together with the adhesive at the edge portion, when forming a liquid crystal display cell whose board gap is as minute as 1-2 μm.

4. Brief Explanation of the Drawings

Fig. 1 is a sectional view in thickness direction of the conventional liquid crystal display cell.

Fig. 2 is a perspective view to explain the manufacturing process of the liquid crystal display cell according to the method of the present invention.

Fig. 3 is a sectional view in thickness direction of one embodiment of the liquid crystal display cell.

11a,11b,21a,21b : a transparent electrode

22a,22b : a transparent board

25 : a spacer member

26 : an adhesive in the center portion

13,27 : an adhesive at the edge portion

Representative Drawing : Fig. 2

⑲日本国特許庁(JP)　⑪特許出願公開

⑫公開特許公報(A)　昭61－7822

⑤Int.Cl.⁴	識別記号	庁内整理番号	㊸公開　昭和61年(1986)1月14日
G 02 F 1/133	123	8205－2H	

審査請求　未請求　発明の数 1　(全4頁)

㊹発明の名称　液晶素子の製造方法

㉑特　願　昭59－127407
㉒出　願　昭59(1984)6月22日

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明　細　書

1．発明の名称

液晶素子の製造方法

2．特許請求の範囲

1．それぞれ一面に電極を形成した一対の電極基板を、それぞれの電極形成面を内側にして対向配置し、周縁部を接着剤により接着固定して液晶表示用セルを形成するに際して、少なくとも一方の基板の中央部において、スペーサ部材を形成した後、接着剤を印刷し、周縁部に設けた接着剤とともに一対の電極基板を接着固定することを特徴とする液晶素子の製造方法。

2．前記スペーサ部材を、一様な成膜ならびにその部分的除去工程を含むリソグラフィー技術により形成する特許請求の範囲第1項に記載の液晶素子の製造方法。

3．基板中央部に形成する接着剤およびスペーサ部材がいずれもポリイミド系樹脂からなる特許請求の範囲第1項または第2項に記載の液晶素子の製造方法。

3．発明の詳細な説明

技術分野

本発明は、液晶表示装置におけるセルの製法に関するもので、特に1～2μmというように微小な間隙を必要とする液晶表示用セルの製法に関するものである。

背景技術

従来、液晶表示装置に使用されるセルは、第1図に示すように、それぞれ透明電極11a、11bを設けたガラス板等からなる一対の透明基板12a、12bを、それぞれの電極形成面を内側にして対向配置し、周縁部においてエポキシ系樹脂接着剤等の接着剤13により接着固定した構成を有する。その際、透明基板間に液晶を封入すべき空間14を与えるための間隔を保持するために、前記接着剤13中にガラス繊維粉砕物、Al_2O_3粉末等で、所定の大きさを有するものからなるギャップ制御材を予め適量混入することによって、セル間隔を制御したり、前記接着剤をスクリーン印刷等の方法で透明基板上に形成した

後、上記のようなギャップ制御材を均一に散布して、透明基板間の間隔を保持しつつ接着固定を行なう方法が行なわれていた。

しかしながら、上記のような方法では、基板間隔に多少のバラツキがでることは避けられず、特に基板間隔が1～2μm程度に狭くなると、生ずる基板間隔のバラツキが表示特性に与える悪影響が無視できなくなる。

発明の目的

本発明の目的は、上述の事情に鑑み、基板間隔が1～2μm程度と微小な場合であっても、均一で安定な基板間隔を有する液晶表示用セルを製造する方法を提供することにある。

発明の概要

本発明の液晶表示用セルは、上述の目的を達成するために開発されたものであり、より詳しくは、それぞれ一面に電極を形成した一対の電極基板を、それぞれの電極形成面を内側にして対向配置し、周縁部を接着剤により接着固定して液晶表示用セルを形成するに際して、少なくとも一方の基板の中央部において、スペーサ部材を形成した後、接着剤を印刷し、周縁部に設けた接着剤とともに一対の電極基板を接着固定することを特徴とするものである。

すなわち、本発明においては、基板の中央部において、スペーサ部材とは別に接着剤を使用することにより、一対の基板の接着固定において、加えられる圧縮力に対しては、スペーサ部材により支承し、また接着固定後においては、接着剤により定められた間隔を維持するために、均一で安定な基板間隔が与えられることになる。特に、スペーサ部材の形成に際しては Å 単位での厚さ制御の可能な成膜技術を利用可能であるため、精密な間隔制御も可能となる。

実施例

第2図は、本発明方法に従う液晶表示セル製造過程を説明するための斜視図である。

すなわち、それぞれITO（インジウムースず複合酸化物）等からなる透明電極を設け且つ必要に応じて液晶配向膜を形成したガラス板等からなる一対の透明基板22a、22bを用意し、まずこの基板の少なくとも一方の上にスペーサ部材25を形成する。このスペーサ部材形成は、好ましくは一様な成膜ならびにその部分的除去工程を含むリソグラフィー技術により形成される。スペーサ部材材料としては樹脂材料が好ましく用いられ、なかでも厚膜形成ができること、液晶の水平配向性がある等の理由によりポリイミドが好ましく用いられる。リソグラフィー技術により例えば厚さが1～3μm、幅5～100μmのストライプ状スペーサ部材25を、0.1～2mmのピッチで形成した後、スペーサ部材12の間に例えば0.1～2mm程度の適宜の間隔で接着剤26を印刷により形成する。この接着剤の好ましい一例は未硬化のポリイミド樹脂であり、これをスクリーンもしくはオフセット印刷等の方法により印刷して例えば厚さ1.0～3.0μm、巾0.1～0.5μm程度の接着剤ストライプ13を形成する。また同様な材質（この場合は、上記の接着剤と同時に塗布できる）あるいはエポキシ系樹脂等からなる異なる材質の接着剤27を周縁部に塗布し、他方の基板と組合せて接着固定する。

第3図は、かくして得られる液晶セルの一例の厚さ方向断面図であり、この例では、対向基板22a上には、電極膜21aを覆って液晶配向用にポリイミド樹脂膜28のみが形成されている。

上記例示の液晶表示セルの具体的な製造例を説明する。

例1

まず透明電極21bを設けたガラス基板上に、γ－（2－アミノエチル）アミノプロピルトリメトキシシランのnブタノール0.3wt%溶液をスピンナーを用い2000rpm、40秒の条件で塗布し、150℃に30分間保持して硬化させた後、ポリイミド前駆体（東レ社製SP－510）の2wt%N－メチルピロリドン溶液を3500rpm、1分間の条件でスピンコートして、更に150℃で硬成して厚さ2μmのポリイミド膜を形成した。次いで、ポジレジストを用いてパターン化し、更にヒドラジンNaOH混合液によ

り、上記ポリイミドを30℃に加熱したピロリドン：NaOH3%溶液＝4：3混合液に5～15分間浸漬してポリイミドをエッチングした後、レジストを剥離してストライプ状のスペーサ25を形成した。

その後再び、上記のように、γ－（2－アミノエチル）アミノプロピルトリメトキシシランのnブタノール0.3wt%溶液を基板全面に塗布し硬化させた後に、上記ポリイミド前駆体SP－510をスクリーン印刷もしくは、オフセット印刷法により、ストライプ26および27のように印刷した。

他方、対向基板22aは、ITO電極21a上に厚さ400～500Åのポリイミド膜28を形成し、ラビング処理したものであって、これを上記のように接着剤を印刷した基板22bと位置合せした後、接着を行ない、40kg／cm²程度の圧力でプレスしつつ、240℃で3時間焼成した。

これにより、2μmの均一な基板間隔を有する第3図に示すようなセルが得られた。

例2

上記例1の方法においては、上下ガラス基板を、ポリイミド接着剤26および27のみによって接着している。このため、プレスの際のガラス基板に働らく応力や歪の解消によって、剥離が生じ易い欠点がある。

これを避けるために、この例では、一旦、基板22b上にポリイミドによるストライプ状接着剤26のみを印刷し、更に対向基板22aと組合せて加圧下に焼成し、両基板を接着固定した後、更に周縁部にエポキシ系接着剤27を塗布し硬化させて、補強ならびにシールする構造を取った。この例ではエポキシ系接着剤27による補強を両基板をプレスしつつ行なったが、プレスを開放した状態で行なうことも可能である。

発明の効果

以上説明したように、本発明によれば、基板間隔が1～2μm程度というように微小である液晶表示用セルを形成するに際して、基板中央部にスペーサ部材を形成した後、接着剤を印刷し、周縁部の接着剤とともに接着固定する構成を取ることにより、中央に設けた接着剤を接着剤兼スペーサ部材として機能させることができ、基板間隔が1～2μm程度と微小な場合であっても、均一で安定な基板間隔を有する液晶表示用セルを製造する方法が提供される。

4．図面の簡単な説明

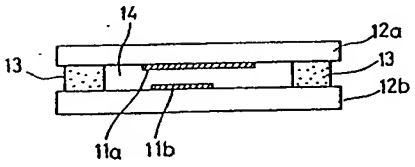
第1図は従来の液晶表示セルの厚さ方向断面図、第2図は本発明方法に従う液晶表示セル製造過程を説明するための斜視図、第3図は得られる液晶表示セルの一例の厚さ方向断面図である。

11a、11b、21a、21b・・・透明電極
22a、22b・・・透明基板
25・・・スペーサ部材
26・・・中央部接着剤
13、27・・・周縁部接着剤

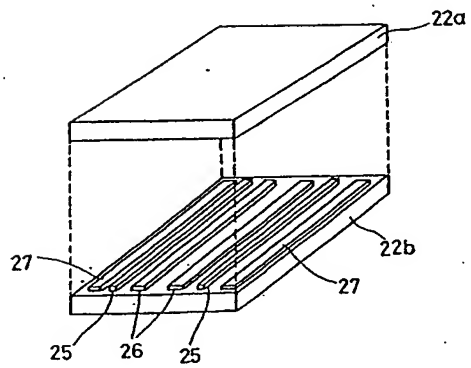
代表図面：第2図

出願人代理人　猪瀬　章雄

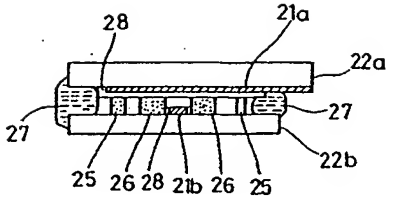
第1図



第2図



第 3 図



1. Title of the Invention

METHOD OF FABRICATING LIQUID CRYSTAL ELEMENT

2. Scope of Claim

A method of fabricating a liquid crystal element comprising: dropping different liquid crystals onto divided parts of a glass substrate divided into at least two parts by a sealing agent, superposing the glass substrate on which the liquid crystals are dropped and the other substrate under vacuum, and curing the sealing agent by heating.

3. Detailed Description of the Invention

(Technical Field)

The present invention relates to a method of fabricating a liquid crystal element, wherein a sheet of liquid crystal element is divided into two or more parts by a circumferential sealing agent, and different liquid crystals are filled in the parts.

(Conventional Arts)

A conventional method of fabricating a multi-color liquid crystal element will be described in conjunction with FIG. 2. First, in (a) process, a sealing agent 2 such as epoxy resin is printed on one surface of a glass substrate 1 using a screen printer so that the glass substrate 1 is divided into four parts to install liquid crystal ports 3a, 3b, 3c and 3d. Then, in (b) process, the other glass substrate 4, at which spherical spacers having a diameter of 8 ~ 9 μm are attached, are superposed on the glass substrate 1 in a pattern matching manner. In (c) process, the glass substrates, on which a weight of 40 ~ 50 Kg is loaded, are disposed in a hot air circulating furnace 7 at 150 °C for 3 hours to cure the sealing agent 2, thereby forming a liquid crystal cell 5 having four cells 5a, 5b,

5c and 5d. In addition, in (d) process, the liquid crystal cell 5 is fixed to a chuck installed at an end of a cylinder 10. A chamber 11, in which a liquid crystal support dish 9 for receiving liquid crystal 8a is installed, is vacuumed by a vacuum pump 12. At this time, the glass gap of 8 ~ 9 μm of the liquid crystal cell 5 is also vacuumed. In (e) process, the liquid crystal port disposed at one side of the vacuumed liquid crystal cell 5 is dipped in the liquid crystal 8a, and the chamber 11 is returned to the atmospheric pressure through an air-opening valve 13. As a result, one of the liquid crystal cells is first filled with the liquid crystal by a pressure difference between the cell and the chamber 11. The other three cells are filled with the liquid crystal through the same processes as (d) and (e) processes to thereby fabricate the multi-color liquid crystal element.

(Approaches for Solving the Problems)

However, the method should perform the liquid crystal filling process four times, and time consumed from the seal print to the liquid crystal filling takes five or more hours. In addition, since the liquid crystal port of the cell is dipped in the liquid crystal to be filled with the liquid crystal, it is impossible to divide the liquid crystal cell into five or more parts.

In order to solve the problems, the present invention provides a method of fabricating a liquid crystal element capable of filling liquid crystal at a high speed, and filling the liquid crystal even though the liquid crystal cell is divided into five or more parts.

(Summary of the Invention)

In order to solve the problems, the present invention provides a method of fabricating a liquid crystal element including: dropping different liquid crystals onto divided parts of a glass substrate divided into at least two parts by a sealing agent, superposing the glass substrate on which the liquid crystals are dropped and the other substrate under vacuum, and curing the sealing agent by heating.

(Embodiments)

Hereinafter, an embodiment of the present invention will be described in conjunction with FIG. 1.

First, in (a) process, a sealing agent 2 such as epoxy resin is printed on one surface of a glass substrate 1 using a screen printer so that the glass substrate 1 is divided into four parts to install liquid crystal ports 3a, 3b, 3c and 3d. Then, in (b) process, desired liquid crystals 8a, 8b, 8c and 8d are respectively dropped onto the divided cells using a dispenser for dispensing a predetermined amount of droplet. Then, in (c) process, the glass substrate 1, on which the liquid crystal was dropped, is set on a lower plate 14a of a vacuum superposing jig. In addition, a glass substrate 4, at which spherical spacers having a diameter of 8 ~ 9 μm were attached, is set on an upper plate 14b of the vacuum superposing jig using clampers 15a and 15b. Then, a chamber 11 is vacuumed by a vacuum pump 12, and the upper plate 14b is lowered using a cylinder 10 to thereby superpose the glass substrates 1 and 4. Then, when the chamber 11 is opened to the air through an opening valve 13, the divided cells are filled with the desired liquid crystals 8a, 8b, 8c and 8d, respectively. In addition, in (d) process, a liquid crystal cell 5 filled with the liquid crystal is loaded by a weight of 40 ~ 60 Kg to be set in a hot air circulating furnace 7, and then, the sealing agent 2 is cured at

150 °C for 3 hours, thereby forming the liquid crystal element.

(Effects of the Invention)

As can be seen from the foregoing, the method of the present invention is capable of remarkably reducing a process time, which conventionally taken five or more hours from the seal print to the liquid crystal filling, since the divided cells are simultaneously filled with the liquid crystals. In addition, though it is vary difficult to prevent overuse of the liquid crystal and to divide the liquid cell into five or more parts, since the conventional art uses the method of dipping the liquid crystal port in the liquid crystal, the method of the present invention is capable of readily filling various kinds of liquid crystals without waste of the liquid crystal, regardless of the number of divided parts of the liquid crystal cell, since the liquid crystal is dropped and then the substrates are superposed.

4. Brief Description of the Drawings

FIG. 1 is a view illustrating a method of fabricating a liquid crystal element in accordance with the present invention; and

FIG. 2 is a view illustrating a conventional method of fabricating a liquid crystal element.

- Description of Major Reference Numerals

1, 4: Glass Substrate

2: Sealing Agent

5: Liquid Crystal Cell